Wisconsin Geological
and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

September 29, 2020

Bend deposit/North Fork Yellow River watershed hydrogeology study

Re: Brief description of the project and field methods employed to support NEPA process

The Wisconsin Geological and Natural History Survey (WGNHS) has been contracted by the US Forest Service (USFS) and Wisconsin Department of Natural Resources Forestry Division (WDNR) to study the hydrogeology of the North Fork Yellow River watershed, located near the Bend ore deposit in Taylor County. This document describes the fieldwork activities planned for this project to support NEPA permitting and approvals.

During the first year of this project, we will install research wells to study water table elevations and flow directions. Water chemistry and sediment cores will be collected at well locations to better understand the area hydrogeology. We will partner with the US Geological Survey (USGS) to install a real-time stream gaging station on the North Fork Yellow River at FR 112. Water-level sensors will be installed in the research wells and in the river. Planned future work includes measuring water fluxes within the North Fork Yellow River (seepage meters, riverbed piezometers), measuring streamflow, and collecting river data via canoe. These objectives will help us characterize the geology and better understand the groundwater connections in this area.

The following sections provide further information about each field method and the expected disturbance from each at the study area. Activities where no disturbance is anticipated (streamflow measurements, water sampling, canoe float) are not described in this document.

Geoprobe drilling

General description

Drilling is used to collect information about the soil profile. Geoprobe utilizes the direct-push method, which drives a small 1-2-inch diameter drill string into the ground using a percussion hammering motion. Examples of the Geoprobe equipment and samples collected from Geoprobe drilling are included in **Photos 1 and 2**. Subsurface samples can be collected from the the unconsolidated soils and sediments to a maximum depth of 80 feet or until refusal of the drill tip on bedrock or large stones/boulders. This method is ideal for obtaining subsurface samples in unconsolidated materials and provides a quick and relatively inexpensive way to obtain a detailed profile of the

geology and install piezometers. Samples are described by WGNHS geologists and documented for future reference. If a proposed drilling location is on private land, landowners will be contacted for permission to access their property and Diggers Hotline will be notified prior to drilling. Boreholes drilled only for subsurface sample collection are immediately filled and sealed according to WDNR standards.

Expected disturbance at Bend site

Three to four wells are planned for the study area. The potential area of impact at each site will consist of a flat area up to 10 feet by 20 feet. Some of the potential well sites are located off the main road on access paths composed of native ground. Access to some of these sites is blocked by boulders, brush, or downed trees (**Photos 3 and 4**). The boulders are located at the access points from FR112. Some additional disturbance or vegetation removal may therefore be needed for access. Potential well locations were selected to avoid access through wet areas. The proposed well locations themselves have limited vegetation and any removal would be incidental.

Photos 1 and 2 - Track-mounted Geoprobe drilling rig (left) and subsurface samples collected from Geoprobe drilling (right).


Photos 3 and 4 – Boulders blocking access to possible well location (left). Example of downed tree along access route (right).

Well and piezometer installation and water level sensors

General description

Wells and piezometers serve as "windows" into the groundwater system and help to refine our understanding of groundwater levels and groundwater flow directions. Examples of wells are included in **Photos 5 and 6**.

Wells and piezometers are typically installed directly into the Geoprobe boreholes. Monitoring wells provide a means for measuring groundwater levels. Similar to the piezometer measurements (see section: piezometer measurements), wells and piezometers help determine if water is flowing into or seeping out of the river and improve the understanding of surface water-groundwater interactions. The wells will have protective casing and locking caps to prevent tampering.

Pressure sensors, or water-level loggers, will be installed in the wells and in the river to measure changes in water elevation. In the river, the sensors will be installed in a PVC casing and secured to the riverbed with a fencepost or rebar, or tied to the bank.

Expected disturbance at Bend site

Disturbance will be limited to the rebar installed in the streambed for the river water-level sensors. Two river sensors will be installed in the same locations planned for stream gaging (see map). Disturbance from well installation will not exceed that included in the description of Geoprobe drilling.


Photos 5 and 6 - Dedicated well measured to determine the water level (left). Dedicated wells will have a protective top and locked cap. Temporary nest of piezometers installed to monitor water levels associated with distinct horizons in the subsurface (right). Multiple piezometers are typically installed when low-permeability layers such as clay separate two distinct aquifer units.

Stream gaging station

General description

A stream gaging station consists of a shelter, usually aluminum, on the bank with conduit leading to a pressure sensor in the stream. The pressure sensor is kept in place with an anchor pipe in the streambed.

Expected disturbance at Bend site

The stream gage setup for the North Fork Yellow River will consist of a 2ft x 2ft x 4ft shelter sitting on four 1.5 inch steel pipes driven into the ground about 2 ft. A solar panel and rain gage will also be attached to the gage structure. 1" conduit will run from the gage house to the stream where there will be a 1.5" anchor pipe driven into the streambed to support the pressure sensor. The stream gaging station will be installed on the left upstream side of the North Fork Yellow River at FR 112 within road disturbance/ right of way. **Photo 7** shows the approximate location of the station. The potential soil disturbance would be less than 5 square feet.

Photo 7 – Looking south along bridge over the North Fork Yellow River at FR 112. The image shows the approximate location of the proposed shelter for the stream gage.

Seepage meter measurements

General description

Seepage meters directly measure the flow of water between groundwater and a surface water feature, such as a river. Seepage meters consist of an open-bottomed cylindrical drum with a hole and plastic bag on the top. The drum is pushed into the river sediment and the bag placed over the hole in the top of the drum. As groundwater flows out of the riverbed into the drum, it fills the bag. The time it takes for the bag to fill with water gives a measure of the amount of groundwater flow. To conduct these tests, staff wade out into 1-4 feet of water and install the seepage meter directly into the riverbed sediment. The seepage meter may be left in place for 24 hours, generally the time needed for the bag to fill, before being removed and repositioned at the next measurement point. A small handful of sediment may also be collected to determine the type of material (e.g., gravel, sand, silt, clay, organic muck) present at the measurement point. A conceptual illustration of a seepage meter installation is shown in **Figure 1** and a photo is included as **Photo 8**.

Expected disturbance at Bend site

Disturbance would be limited to the seepage meter itself, which is temporarily installed in the riverbed. Locations for seepage meters have not been selected yet. This is planned for later than June 2021.

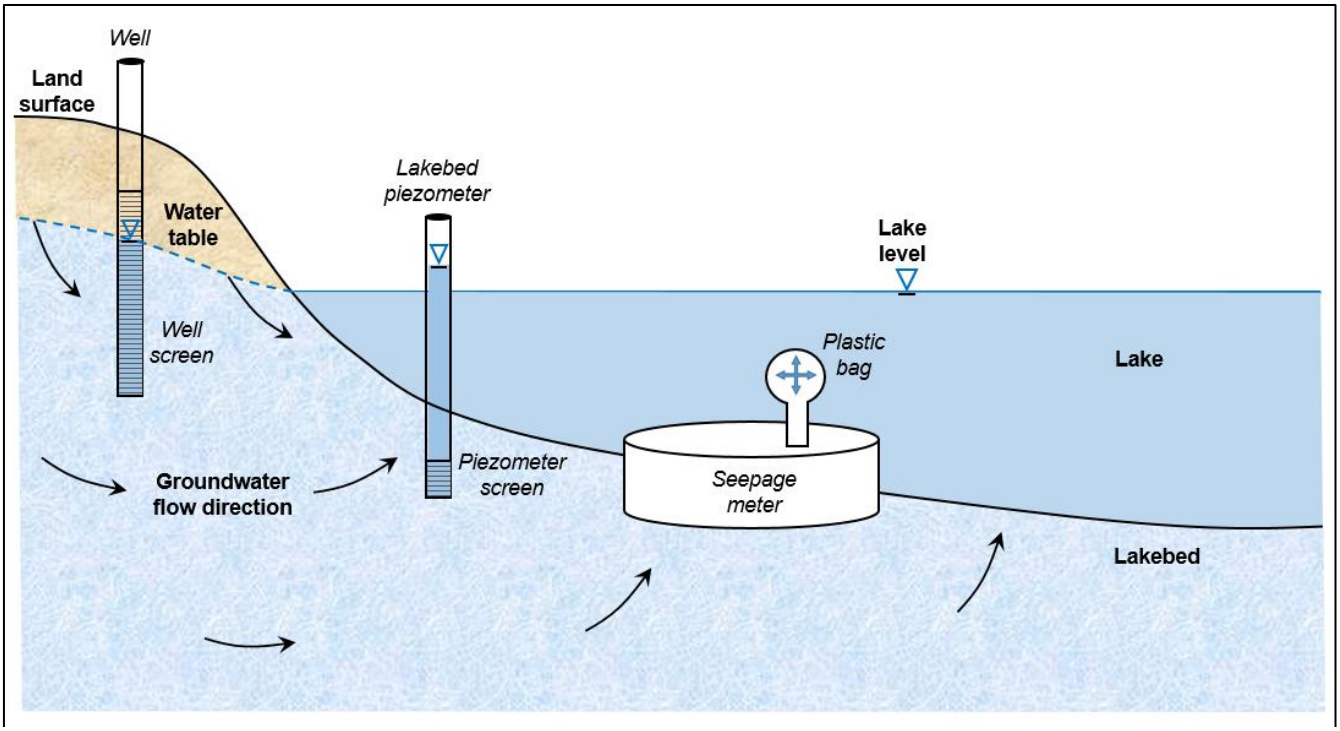

Figure 1 - Illustration of a well, lakebed piezometer, and seepage meter deployed at a lake. Although this figure shows a lake, the same concept applies to a river. Groundwater is shown moving towards, and discharging to, the lake. In this example, where groundwater discharges to the lake, the water level in the lakebed piezometer rises above the lake level and the plastic bag on the seepage meter inflates. If conditions are reversed, and lake water seeped into the groundwater system, the water level in the lakebed piezometer would drop below lake level and the plastic bag would deflate.

Photo 8 - Seepage meter installed in a lakebed. The same approach applies for installing in a river. Clear plastic bag is visible, extending upwards from the top of the orange cylindrical drum. A lakebed piezometer, the plastic tube with red tape, is located in the background.

Riverbed piezometer measurements

General description

A piezometer is a well designed to measure water levels at a specific depth. For example, measuring the water level 1-3 feet below the riverbed helps determine if groundwater (water below river bottom) is moving upward or

downward in relation to the river. Water levels above the river level indicate that groundwater is discharging to the river, while water levels below the river level indicate that river water is seeping down into the groundwater system. To conduct these tests, staff wade out into 1-4 feet of water and install a piezometer 1-3 feet down into the soft riverbed sediment. The piezometer is typically in place only long enough to take a pressure reading (sometime between 5 minutes to 2 hours), before being removed and repositioned at the next measurement point. A small handful of sediment may also be collected to determine the type of material (e.g., gravel, sand, silt, clay, organic muck) present at the measurement point. Occasionally, piezometers are left in place for longer periods of time (2-5 days) to collect riverbed temperature measurements. These piezometers are placed to avoid boat traffic and flagged with markings so that the equipment is visible to boaters and others recreating on the river. A conceptual illustration of a riverbed piezometer is shown in **Figure 1** and a photo is included as **Photo 9**.

Expected disturbance at Bend site

Disturbance would be limited to the piezometer itself which is temporarily installed in the riverbed. Locations for piezometers have not been selected yet. This is planned for later than June 2021.

Photo 9 - Example of a lakebed piezometer. Although this photos shows a lake, the same concept applies to a river. Note the water level in the piezometer is 10” above the lake level, showing groundwater is moving into the lake at this location.